Jenesys Associates

Cardiff University Science Sessions 2018

Evaluation Report

For the School of Pharmacy, Cardiff University

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Contents

1. Introduction

This report presents the evaluation findings of a science outreach project that was delivered by Cardiff University's School of Pharmacy in the autumn term of 2018. The project targeted children in primary school Key Stage 2, with some in secondary school Year 7 also taking part. Professional evaluators Jenesys Associates Ltd supported the evaluation of the project and this report presents the findings.

1.1. About the Project

The Cardiff University School Science Sessions project was seeking to advance on the School of Pharmacy's 2017 Science Club outreach and engagement project with primary schools in Newport. This year's project sought to deliver science activities to a cluster of 5 Cardiff primary schools and a secondary school for which 4 of the primary schools are feeders. With funding from the Waterloo Foundation[1] and in collaboration with Cardiff Council and construction company Willmott Dixon[2], the project was seeking to build on last year's successful project in order to involve more schools and local students.
Primary schools were offered three sessions a few weeks apart:

- Session 1 – in their school
- Session 2 – held in their school for some cohorts and at the high school for others
- Session 3 – visit to the University (one primary school could not attend)

The secondary school took part in one session at the school and the visit to the University.

1.2. About the Evaluation

The evaluation team's support comprised the design and development of evaluation materials to capture feedback from schools students, teachers and university researchers; observing selected delivery; and collating, analysing and reporting all feedback.

1.2.1. Evaluation aims

The evaluation had the following aims:

1. To evaluate the experiences and outcomes provided by the Schools Science Sessions for:
    a. School students
    b. Teachers
    c. Participating University researchers/staff/students
2. To identify factors that influences the outcomes, positively or negatively.
3. To identify learning and recommend improvements for similar projects in future (based on 2017 and 2018 iterations of the project).

1.2.2. Evaluation methodology

Evaluation data and feedback were collected from all stakeholder groups using a mix of quantitative and qualitative methods shown in the table overleaf.

[1] http://waterloofoundation.org.uk/
[2] https://www.willmottdixon.co.uk/

	Students	Teachers	University
Baseline (pre-delivery)	183 x questionnaires	5 x questionnaires	
Session 2 (in one school)	1 x observational log		
End-of-project (session 3)	3 x observational logs 193 x questionnaires	12 x questionnaires	7 x questionnaires

In addition, an interview was conducted with a representative of Cardiff County Council to obtain some further context for the project and to inform the reporting.

1.2.3. Reporting

Quantitative data for large numbers of respondents are presented as percentages, which have been rounded and when totalled may be slightly greater or less than 100.

Thematic analysis was used to analyse qualitative data such as the open responses to survey questions. Where appropriate, representative quotes have been used to illustrate findings. All quotes have been anonymised to maintain confidentiality. Teacher quotes are shown in *purple italic* and students are in *orange italic*.

Section 2 of this report presents students' and teachers' baseline data, including teachers' motivations and expectations. Section 3 presents feedback about experiences, delivery process and the project structure for teachers, students and University contributors. Section 4 reflects on the outcomes for all stakeholders. Section 5 summarises some key learning points and Section 6 outlines a concluding statement.

2. Findings: Baseline

2.1. Teacher motivations and expectations

Teachers described their reasons for taking part and their expected outcomes from the project in pre-project baseline feedback. Most commonly reported was the desire to engage their students with science in order to increase enthusiasm and interest in the subject.

Raising interest level in science generally – seeing it in a different context.

Inspiring the children to become more engaged with science!

Engage pupils – encourage their ability to investigate.

Raising the profile of science generally; making science more realistic and hands on.

Inspire pupils in the school to pursue science further (especially girls).

As mentioned in the previous quote, many teachers mentioned reaching more girls and breaking down existing stereotypes around science, hoping that improving the students' understanding of science and scientists would break down any false preconceptions.

Breaking stereotypes & preconceived ideas about science for these children…

I would hope that the children will feel enthused, and that any misconceptions regarding stereotypes will be addressed.

Inspire pupils to become more interested in science – especially some of the girls.

It is worth noting that the team of University leads for the sessions consisted of a main female scientist supported by a male scientist. Therefore it may be that the teachers anticipated a positive effect from the presence of the main female lead providing a strong role model, rather than it being a pre-existing motivation.

Another common motivator was that teachers felt these sessions would develop their scientific teaching, which was described when asked what they anticipated would be the main outcomes for their school more widely.

[It will] Enable teachers to consider 'new' ways of teaching science alongside technology as Donaldson requests.

Gaining ideas on how to deliver science sessions, whether that be knowledge or investigation.

An insight into professionally planning/conducting/reviewing science experiments/investigations.

Model to teachers how scientific knowledge and skills can be taught in an engaging way.

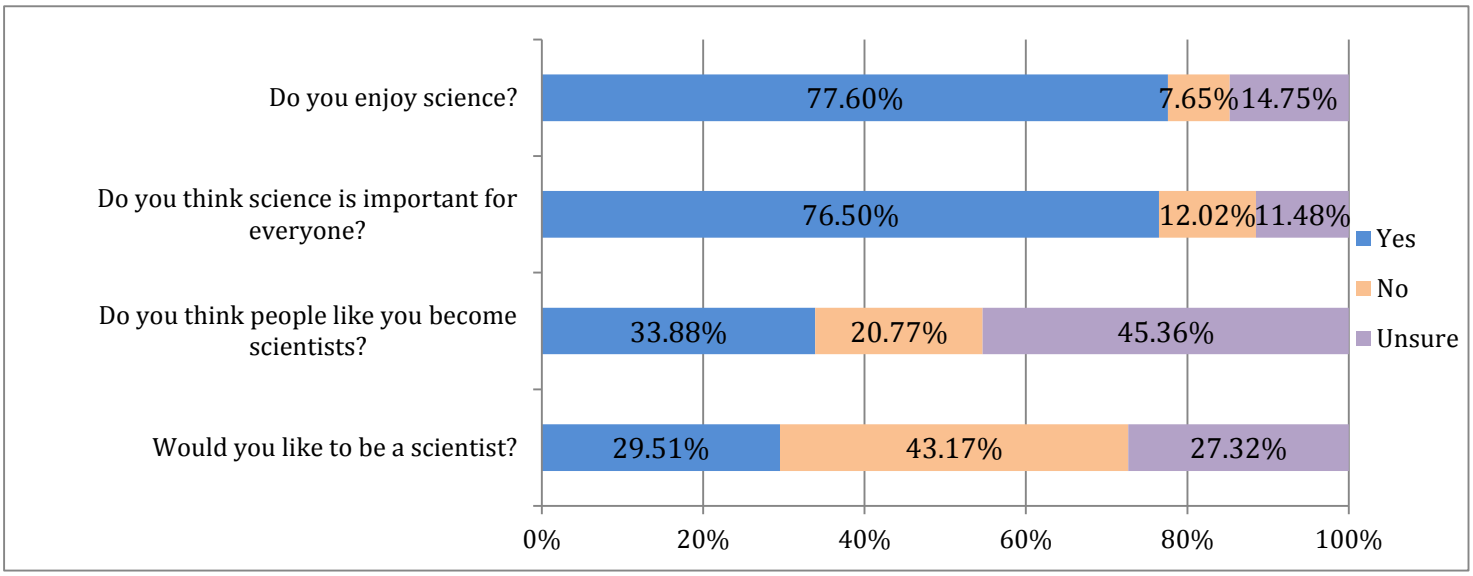
2.2. Student baseline attitudes to science

All students were asked to complete a baseline questionnaire to gauge their attitudes and aspirations towards science. They were asked four questions, and then asked to list 3 words that they associate with science. The four questions were as follows:

- Do you enjoy science?
- Do you think science is important for everyone?
- Do you think people like you become scientists?
- Would you like to be a scientist?

As shown in the graph overleaf, the majority of pupils (77.6%) reported that they 'enjoyed science' and again most (76.5%) pupils also thought that 'science is important for everyone'. This is consistent with previous year's evaluation data, showing that the majority of Key Stage 2 students already have positive attitudes towards science and recognise its significance in the world.

Students' baseline attitudes towards science (n=183)



One third (33.88%) of students thought that 'people like me become scientists', however the most common response (45.36%) was that students were unsure, perhaps showing limited understanding of what a scientist is or what kind of people become scientists.

Just under half (43.17%) of students reported that they would not like to be a scientist, with under a third (29.51%) indicating they would like to be a scientist. These results show that whilst students view science as enjoyable and important, they do not connect that opinion with their own lives or aspirations. These results are fairly consistent with previous year's evaluation data.

When choosing three words that describe what they think about science, students almost universally used positive words. Particularly words such as 'fun', 'exciting' and 'happy' were very popular. This is consistent with the data shown in the previous graph, emphasising the students' positive views about science. Only 8% of the words within the sample were negative, of these the most commonly occurring was 'boring', which is a commonly used negative word associated with science. On the whole, the results are consistent with last year's evaluation and previous evaluations undertaken with this age group of students.

2.3. University and contributor motivations and expectations

Whilst the University have not shared any specific written aims over the first two years of running this project, our previous conversations with lead staff members summarised their motivations as wanting to show students from a wide range of backgrounds the possibility that they can go on to study or work in science. Similarly this year, comments from university contributors and staff to the evaluation team explained that many of them saw the goal as engaging children from all backgrounds with science, and showing the children the genuine and varied faces of science.

At session 3, all volunteers (e.g. STEM ambassadors), presenters and contributors were asked to complete post-event feedback forms which explored their motivations and experiences of the project. The most common motivation for many was to share their enthusiasm for STEM in order to inspire and educate the students in a fun way. Almost all contributors saw this project as a good opportunity to develop their communication skills and improve their methods of sharing scientific knowledge.

3. Findings: Experiences

This section summarises the experiences for each of the three main stakeholder groups – teachers, students and university contributors.

3.1. Teacher experiences

3.1.1. Overall opinions

In post-event feedback collected at session 3, teachers generally rated the project highly, with all giving a score of 4 or 5 on a scale of 1-5, with 5 being the highest rating. The reasons for their high satisfaction with the project focused on the interactive and engaging nature of the sessions; the fact that the students got to visit the University and how this added to the overall effect of raising the students aspirations; increased student awareness of the breadth of science careers; and the well planned structure to the project.

All the sessions were very interactive and were all very well presented. Very interesting activities that all the students enjoyed.

Overall it has been a good experience for our pupils to have exposure to the University and see University as something that is achievable for them.

The children have been engaged throughout the sessions and many have been inspired to be scientists/construction workers when they are older!

3.1.2. Project Structure

Feedback regarding the general structure of the project (three sessions across one term) was generally considered a success and the variation between sessions was seen as a major contributing factor. For schools that visited the secondary school for session 2, the visit was seen as a positive aspect for building links between the high schools and the primary schools and for potentially helping the students in transitioning to high school.

Pupils have enjoyed the sessions – the structure was excellent with the class-based session leading to the lab-based session before culminating at the University.

Pupils thoroughly enjoyed visiting [the secondary school] and the University.

Visit to the school and also a science lesson at [the secondary school] (our feeder school) was great for transition to high school and for pupils to familiarise themselves with science labs in high school. There was a good number of visits even though I know the children would've loved more.

However, it was observed that the structure was not identical for all students. The format of session 2 differed between schools, as not all had the opportunity to visit the secondary school and therefore those students and teachers would have had different experiences of the project.

3.1.3. Suggestions

There were a few suggestions' to improve the project from the teachers. These focused on the logistics of the sessions; the timing of the sessions; and the lack of bilingual resources/activities, as one of the schools was a Welsh first language school.

A number of teachers noted that the timing of the project could be better, to allow the material from the sessions to be explored in more depth between each session and to avoid the busy pre-Christmas period (one school was unable to attend session 3 held in late December because of a very busy school schedule). The evaluation team is unaware of how much input the teachers had into helping plan the sessions this year, however in the previous year the project lead met with a number of teachers from the involved school cluster to develop the project structure and content. The evaluation team would recommend that these planning sessions are included every year in order to

ensure the session content and structure are as effective as possible and remain fit for purpose and up-to-date with curriculum changes.

Number of visits was good to the school. However there was a short amount of time between sessions to complete the tasks.

Structure of the programme was great. The only way to improve would be to start earlier in the term as to avoid the December period.

One teacher also identified the difficulty in having large groups of students together for sessions in the visits to schools.

School visits are great but having 50+ pupils for a whole morning sat in one classroom is hard on the pupils. Consider splitting into shorter sessions, one class at a time.

From our observations we agree with the above and recommend that for any future project the structure of the sessions is revised with input from the teachers. From observations performed at session 3 we found that in large group working often many pupils were becoming demoralised if they didn't understand the content and were losing interest. In contrast, the session 2 we observed involved c. 30 students with small group working, which enabled all students to be engaged and participate as fully as possible. We would recommend this number as a maximum to optimise experiences and outcomes for all students.

Due to the inclusion of a Welsh first-language school, the criticism of a lack of Welsh language resources is fully endorsed by the evaluation team. It was noted during session 3 that the project banners, certificates and other branding were also not bilingual. If this project were to continue in the future we would endorse the suggestion of including bilingual or multilingual resources so as to not alienate Welsh speaking students or English as an additional language students. This is reinforced by teachers' feedback in the baseline questionnaire, where many worried that students who did not speak English as a first language would struggle with learning advanced content and that the sessions would not have their desired impact.

Please provide resources bilingually e.g. certificates, booklets

As we are a Welsh medium school, sessions through the medium of Welsh would be beneficial. Perhaps the Welsh speaking lecturers and students could lead certain workshops.

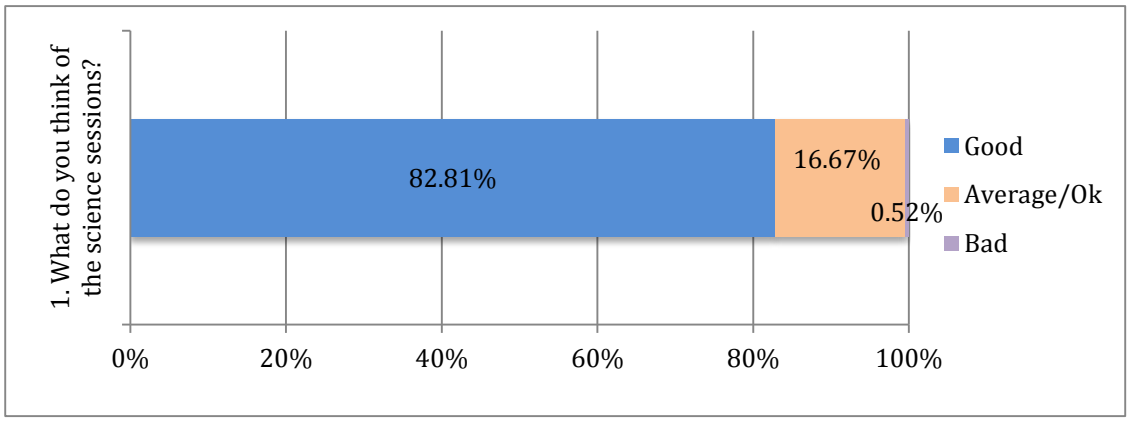
3.2. Student experiences

3.2.1. End-of-project feedback

During session 3 at Cardiff University, students from all schools present were asked to complete post-event feedback during one of the rotation of activities they experienced. Some students who completed the post-project feedback had not been present at session 1 and/or 2, and likewise some who attended the earlier sessions and completed the baseline questionnaire may not have been present at session 3 and therefore would not have completed the post-project feedback, meaning individual comparisons are not possible. However the majority of the student cohort was the same.

As shown overleaf, the majority of students (82.81%) report a positive experience from the school science sessions. With the majority of the remainder rating the experience as 'Average/Ok'. Many of the latter group reported that they weren't that interested in science generally and therefore this view affected their experience.

Students' opinion about the overall project (n=193)



Students who answered this question with 'Average/Ok' also reported that they found some of the science hard to understand, and many felt that people like them don't become scientists and didn't want to be scientists themselves. This general negative perception of science may have impacted their enjoyment of the sessions and shows that the sessions were not successful in changing this minority of students' views about science.

The overall positive response to the sessions is reinforced by observations performed at during session 2 and session 3, with most students being actively engaged when involved in activities and their enthusiasm to follow instructions and advance through most activities being evident. Students however were less engaged when activities were less clear, without defined learning outcomes and instructions.

Whilst the overall impression was that the students enjoyed the activities in session 3 at the University, some activities, such as the 'Brain Jigsaw Puzzle', appeared abstract and disconnected to the rest of the activities. This was in contrast to session 2, where the in-school session had clearly defined outcomes and the presenter explained connections between different content elements.

A lack of both clarity and connection around some elements in session 3 meant in these cases students without direct guidance and interactions quickly lost interest. Similarly the 'Stroop Mats' activity engaged children through active learning, and when given the opportunity to reflect at the end many children asked questions about 'why' the activity had the effect it did. However during some sessions this structure wasn't followed, with less explanation and no reflection, which led to some students merely racing without consideration of what they were doing. This ended up in a few students becoming visibly upset and therefore having a very negative experience. Whilst it was a minority of students that had negative experiences, there is scope to adapt these activities slightly to ensure positive experiences for all students.

3.2.2. Student Highlights

At session 3, students highlighted their learning through the project. The most common topics were:

- Bacteria and antibiotics – Bacteria swabbing investigation
- Bees and antimicrobial honey –experiment
- Brain facts – Brain games

The first two of this list were part of sessions 1 and 2, which suggests most students retained some learning and had found the topics memorable, suggesting they particularly enjoyed the learning experience around those topics.

I learnt that antibiotics are not working on bacteria and bacteria is finding new ways to fight the antibiotics so scientists have found honey from bees to use.

I thought the sessions were interesting and had a lot of information. E.g. we learnt that bees make honeycomb out of circles but when honey goes in it turns it into a hexagon.

I learnt that an adult brain weighs the same as a Chihuahua. If you put both of your fists together that is roughly the size of your brain. If science didn't exist, things like medicine wouldn't exist. I also learnt that bees could come to the rescue!

Many students also focused on the fact that they got to get out of the classroom and experience new environments at the secondary school and university. Being active while learning was clearly a positive factor and during observations we found that the students were eager to get involved and engage with each activity, and seemed to be full of questions about the science on display.

The inclusion of Wilmott Dixon's construction activity and talk in session 3 was also mentioned, and seemed to have a positive impact on demonstrating both the breadth of science to the students and its real world applications.

I learnt that bees store their honey in circles and then turn into hexagons when they squash together… I also learnt that in a construction team there are different types of scientists.

I learnt that construction needs science to help sometimes and a scientist can look like a normal person.

3.3. University experiences

The enthusiasm and connection between the students and the University leads was clear in all observed sessions. Many students and teachers mentioned the University lead and their effectiveness in their post-event feedback. Contributors and presenters all rated the project as 'Very Good' or 'Good' in helping them achieve their aims and described extra individual impacts that the project had on them, such as learning about public engagement and satisfaction in being able to inspire students.

3.3.1. University suggestions

Suggestions from all contributors and volunteers were captured through questionnaire feedback and discussions during session 3. Nearly all had not experienced session 1 and 2, meaning their feedback is based on session 3 only. Their suggestions centred on the need for students to have more time on the session 3 activities and for themselves to have more time in preparation. Many expressed the feeling that the presenters needed more time than had been afforded to prepare with the activities, in order to understand them fully and work out effective ways to communicate them. They also mentioned that if slightly longer was allocated to each of the activities in session 3, it would give the students more time to grasp the activities and understand and reflect on the benefits and any learning.

Based on our observations, we would endorse the above points as improving the experience for contributors and optimising the experiences and outcomes for students.

During the project, the University lead expressed some concerns about varying levels of engagement by different primary schools. We explored this in interview with Cardiff Council, which confirmed our own experiences of a range of different engagement levels being found within a single school cluster. This was conveyed to the University lead, allaying their concerns. However we would advise the University to discuss in confidence any potential engagement variation or other potential issues with the Council if the project is to be repeated in future, to minimise potentially distracting concerns for University staff.

4. Findings: Outcomes

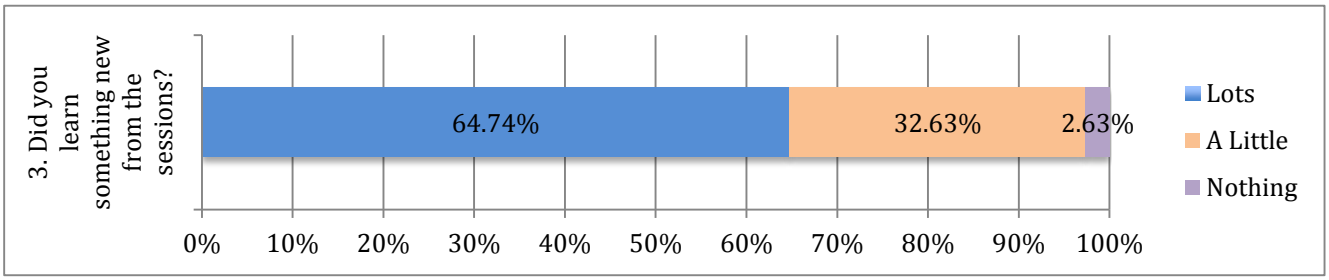
This section reports the students outcomes from the project overall, as well as teachers reflections on their perceived outcomes for their students and themselves individually. It also includes outcomes from the University volunteers, contributors and presenters.

4.1. Student Outcomes

4.1.1. Impacts on student knowledge

Almost all students (97.37%) reported learning at least 'A Little' from the project. Qualitative analysis of post-event feedback forms found most students answered the question 'Please write or draw something you learnt' by recalling multiple facts or making drawings related to the main learning topics of the sessions, namely: bacteria and microbial resistance; bees and antimicrobial honey; brain function and structure. Many students also mentioned or drew things from the construction activity hosted in session 3 by Willmott Dixon.

Students' views on how much they learnt from the science sessions. (n=193)



Whilst many students mentioned facts they had learnt about the brain, this may be due to the close proximity of the feedback session to the *'Brain Games'* activity in session 3. However, the learning examples regarding bacteria, and how bees can be used instead of antibiotics far outnumbered the other topics, indicating good levels of recall from sessions 1 and 2. Another common learning example was regarding the structure of honeycomb in beehives, with 'orbeez[3] experiment' frequently mentioned.

Another outcome was the widening of students' understanding of science and the wide range of topics that science covers. This was reiterated by teachers in their feedback forms, with many praising the breadth of knowledge their students had been exposed to. The fact that this science was shown in real-world contexts was seen as very important, connecting the students with a tangible form of science, which was an aspiration for teachers at the start of the project.

> *I thought the sessions were very educational and I learnt a lot. Before, I didn't know there was so much to know about science. Science is important because it has an important part in things in general. For example construction, bacteria and even maths!*
>
> *I think the children have gained a greater understanding of the broad roles of scientists. Also, a greater understanding and appreciation of science within the wider world and in real-world contexts.*
>
> *I hope it has broadened their knowledge of bacteria and the science that happens in Cardiff on their doorstep.*

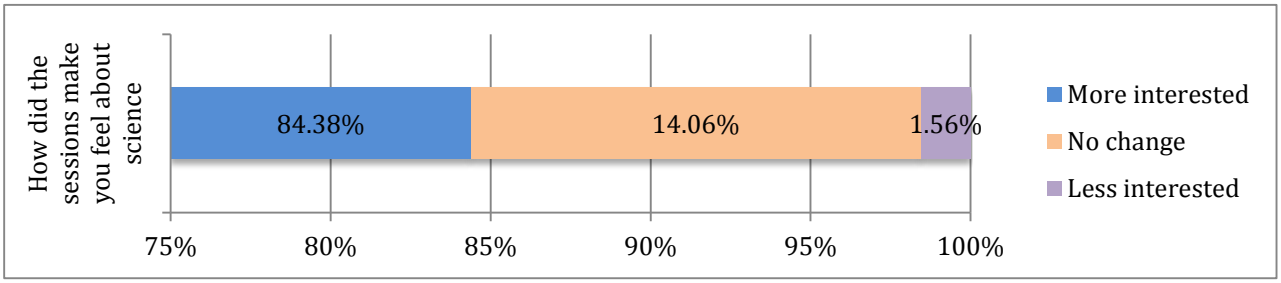
[3] Orbeez are superabsorbent polymers that grow in volume when placed in water.

4.1.2. Impacts on student attitudes towards science

Impact on interest in science

Post-project feedback below shows that the majority (84.38%) of students reported increased interest in science as a result of the science sessions. These results are fairly consistent with last year's evaluation data, supporting the evidence of the positive impacts that the project has on participating students.

Student views on how their interest in science was affected by the project (n=193)



Qualitative feedback indicates that a major contributing factor to increased interest was the greater understanding of the breadth of science, as mentioned above. Many students found that understanding the real variety of science made the subject more interesting and relevant to them.

The sessions were good, they helped me understand a lot more about science (P.S there's a lot more to it than what I thought!)

I thought the science sessions were very educational and I learnt a lot of different things. I really liked the sessions and I got to know a lot of things and I might be a scientist but I don't know.

Pre- and post- project comparison of student attitudes towards science

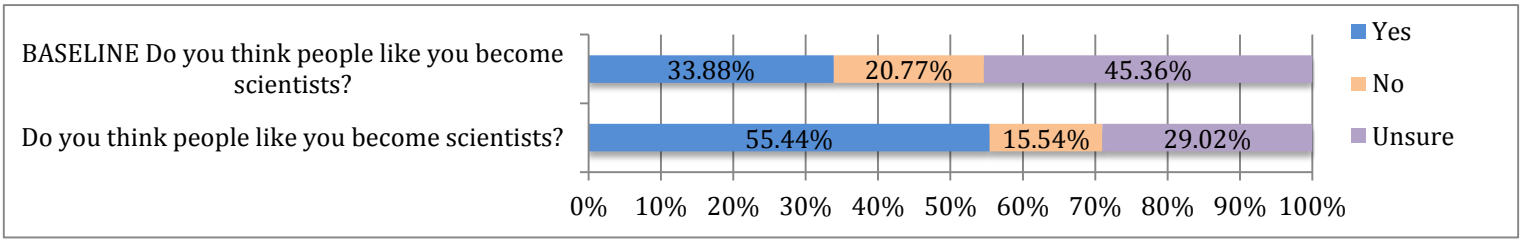
The post-project questionnaire repeated 3 questions about students' attitudes towards science from the baseline questionnaire.

- Do you think science is important for everyone?
- Do you think people like you become scientists?
- Would you like to be a scientist?

Whilst there was a negligible decrease in the percentage of students who thought science was important for everyone (-1.50%), there were increases in the proportion that reported feeling people like them can become scientists and in the proportion feeling they would like to become scientists.

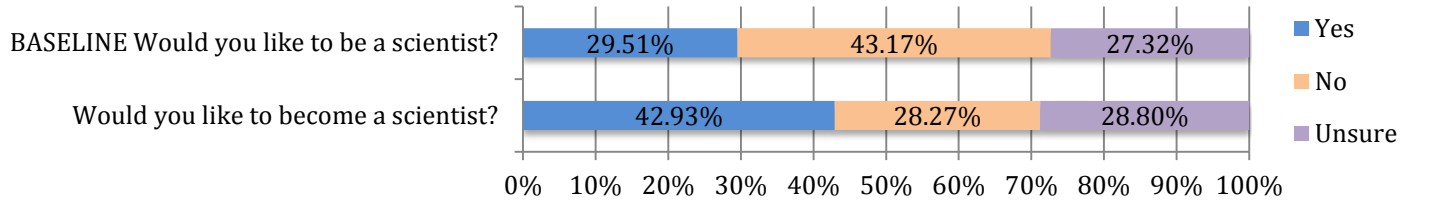
The following graph shows a 21.5% increase in students who think 'people like me become scientists'. This demonstrates that attempts to show the diverse range of science, variety of scientists and to raise aspirations of students through contact with the University has been effective. Although these results do not show demographic data, future evaluations could include breakdowns by gender, to see if the project is reaching female and male students equally in this way.

Student pre- & post- project views on thinking people like them become scientists (n=193)



As presented next, the post-project feedback saw an increase of 13.42% in students who felt that they would like to become a scientist. This is in line with the positive feedback throughout the project, and is likely down to the increased enthusiasm and increased awareness of science careers available. As also mentioned by teachers in their feedback, the sessions have collectively appeared to increase the aspirations of students, and to show them that University and science careers are attainable for them.

Student pre- & post- project views on wanting to be a scientist (n=193)



4.1.3. Teacher-reported outcomes for students

Teachers outlined what they felt would be the main outcomes from the project for their students. Many teachers focused on the increased scientific knowledge that the students gained, not just about specific topics but also their understanding of the breadth of science and its real world applications.

> *I hope it will increase the children's opinions of science and broaden their knowledge of what science is and covers.*
>
> *Inspiration and an insight into what being a scientist actually*

4.2. Outcomes for teachers

When describing their own outcomes, the majority of teachers mentioned how the project would benefit their lesson planning and how they had improved their own scientific knowledge. Another outcome that many outlined was the improved links between the participating schools and with the University, with the hope that these connections would lead to more opportunities in future.

> *It has expanded my own scientific knowledge and I have taken what I've learnt into planning and preparing follow up lessons for the pupils.*
>
> *Will try to link class-based science to relate to real-life problems and issues that concern the pupils.*
>
> *Great development of University links > access to resources and equipment we would be unable to access.*
>
> *Explore possibilities to work with local primary and secondary schools in the future.*

4.3. Outcomes for the University

The University organisers were very pleased with the strong links that were built with the local primary schools, the secondary school and Cardiff Council. Volunteers and contributors stated the main outcome for them individually was being able to develop their personal communication skills, and being inspired to take part in more science communication or public engagement projects.

Another outcome for the University, which emerged in the interview with Cardiff Council, is the Council's wish to see the project rolled-out to other clusters in areas of Cardiff. As schools engagement is undertaken in addition to staff and students' regular roles, resourcing such expansion would require careful consideration.

5. Findings: Project Processes

This evaluation was commissioned by Cardiff University School of Pharmacy, and they intend to use it to refine and inform future schools engagement projects. To aid this we have summarised a number of key learning points associated with the project planning and delivery processes. These points are the combined findings from the last 2 years of the project.

5.1. Planning and development

- The University should adopt a co-development approach involving teachers wherever possible to ensure activities are best-matched to target age groups and school schedules and to ensure optimum fit with curriculum priorities.
- Wherever possible, online tools should be used to enhance the co-development process for teachers and allow them to communicate their requirements with ease. The use of doodle polls aided with logistics and planning this year.
- Clear links between any engagement activity and the teaching curriculum optimise school uptake and help teachers to secure senior management support for involvement. Involving teachers in co-development allows for activities to be adapted to remain relevant with curriculum developments. Many teachers highlighted that the curriculum links within the sessions were not very direct, however the curriculum is changing in 2020, which provides an opportunity to strengthen curriculum links and means co-development will be essential in future.
- Planning the evaluation activities as an embedded part of the programme was particularly successful in gathering student data. However, there was significantly less data from teachers in 2018 compared to 2017, which was mostly due to the University lead leaving after session 3, which meant they were not available to facilitate and chase post-project teacher feedback, as happened in 2017. As a consequence the decision was made to capture all teacher feedback during session 3. Moving forward, opportunities to embed teacher feedback in delivery should be explored as this approach would be beneficial in providing richer data.

5.2. Delivery

- Rehearsing individual activities and investigations (possibly via phone discussion) with teachers would help optimise both their suitability for audiences and their impacts. Rehearsing could also enhance presenter confidence and familiarity, should this be an issue.
- Activity outcomes should be rehearsed or shared within the presenter group. Such sharing would enable any synergies in content to be identified, which could be cross-referenced for students, thus enhancing their experiences and learning. It would also help to optimise the suitability of all activities for the target age groups, ensuring they are pitched at the correct level of complexity.
- It is important that University-based activities are of a quality consistent with activities delivered in-school, both in terms of their scientific content and their planned structure/format. It is important that there are clearly defined learning outcomes explained to students, as this would have enhanced outcomes from in-university elements.
- University-based activities need to be well structured, linked together and have clear opportunities for learning reflections. For example, the 'Brain Games' would be more engaging if the different activities were connected by a narrative of some kind e.g. role

playing as neurosurgeons/doctors. Actions as simple as connecting the 'Stroop mat' and the 'Brain Jigsaw' activities to show which areas of the brain effect the 'Stroop Mat' would lead to a more cohesive activity and optimise student outcomes.

- Whilst the 'Draw a Scientist' activity, which featured in session 1 and session 3 work books, is enjoyed by students, it is important that in its current form it is not used to deduce outcomes from the project. This is because drawings were often observed to be influenced by advice from teachers and staff. If it is to be included for assessment purposes, then enhancements would include removal of external influence and allowing time for students to make their own conclusions and fully annotate and explain their drawings, as this would provide better understanding of their views
- Whilst it is recognised that the use of different volunteers is not unusual in schools engagement, steps should be taken wherever possible to ensure that as far as possible activities are delivered consistently by well-trained individuals. Conducting tailored training sessions for volunteers optimises the likelihood that every student experiences the same well-rehearsed, high quality presentation for each activity, therefore improving the effectiveness of the activity.
- If similar University visits continue in the future, moving to a single school involvement per visit per day (or even a maximum of two schools) would reduce schools feeling rushed and allow students to explore the activities in more depth and get a 'real' feel for the University, including seeing laboratory facilities or other areas where science is carried out.
- The addition of 'action at home' suggestions and activities for students to undertake with their families, if they are motivated and want to explore the topics further, would maximise the likelihood of positive impacts on science capital[4], a measure of why some people engage with science and others do not. Follow up lesson activities could also be created and shared online with schools, to improve the sustainability of the project and help embed the content in teaching beyond the sessions delivered by the University.
- Helping teachers promptly with all queries or questions related to a project maintains their enthusiasm and develops their knowledge. Having a structured system for the provision of such support increases the level of 'buy in' from these teachers and improves the overall project.

[4] https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/science-capital-research-0

6. Concluding Statements & Recommendations

Over the two years of the Cardiff University Schools Science Project/ Sessions, the feedback from students and teachers alike has been overwhelmingly positive. There is sufficient evidence to conclude that the project has delivered positive outcomes for the students and teachers that participated.

A particular success this year was the involvement of a cluster of local schools and their feeder high school. The inclusion of the high school not only helps with easing the immediate transition for Primary students, but allows them to see a pathway in education all the way to university. The relationships developed through this project between teachers and staff have great strategic potential for further STEM outreach and engagement.

This year's major success factors were the broad range of science taught and displayed, the relevance and real-world contexts this science was taught in and the enthusiasm and direction of the University leads in developing the project and working with the teachers and students effectively.

Over the 2 years the approach of showing a broad range of science and scientists has been very successful, and having interactions directly with scientists has been found to be extremely effective in increasing enthusiasm and raising aspirations of students. However there is still room for improvement to maximise the outcomes from future similar programmes.

Based on the evaluation findings we would recommend the School of Pharmacy to:

- Build on the relationships formed with funders like The Waterloo Foundation, Wilmott Dixon and Cardiff City Council in order to expand the project and include more schools.
- Continue to incorporate practical, interactive learning that allows students to explore investigations themselves. These features kept the sessions fun and exciting for students, and allowed students from a wide range of backgrounds and abilities to benefit.
- Analyse the relevance of each stage of the project. Whilst it was clearly beneficial that students were exposed to a variety of topics, a central theme or narrative to connect them could improve learning outcomes. Flexibility around these activities would also ensure the activities can be designed to stay relevant with curriculum developments
- Ensure a co-development approach is used when planning sessions, including the school visits. Information from the teachers suggests large classroom sessions this year could have been improved with smaller class sizes.
- Support key teachers and senior leaders at schools to ensure commitment and encourage them to share their experiences across and beyond the participating cluster of schools.
- Continue to use online methods of communication with teachers as it is more accessible and allows them to quickly plan and make arrangements.
- Explore the possibility of longitudinal follow-up evaluation if schools agree to become long-term partners. This would allow exploration of long-term impacts on students.
- Explore the possibility of including other departments within Cardiff University. For example students on the Science Communication Masters[5] course could be a useful source of advice, consultation and possibly well-trained volunteers.
- Return to obtaining post- Christmas online feedback from teachers, as handwritten feedback forms this year were rushed and lacked detail.

[5] https://www.cardiff.ac.uk/study/postgraduate/taught/courses/course/science-communication-msc-full-time